

What is claimed is:

- 1 1. A method of implementing a user interface to an application,
2 comprising:
3 storing at least one description document conforming to a user
4 interface object model, defining a user interface and comprising one or
5 more definition elements;
6 storing at least one description document conforming to the
7 user interface object model, defining interaction of the user interface with
8 the application and comprising one or more interaction elements;
9 storing a plurality of layout objects each comprising a control for
10 rendering a different definition element;
11 storing a plurality of connector objects each comprising a
12 control for rendering a different interaction element;
13 reflecting the description documents into the object model to
14 generate an instance of the object model defining the user interface and
15 comprising the definition elements and the interaction elements of the
16 description documents;
17 downloading from storage layout objects corresponding to
18 definition elements in the instance of the object model;
19 making interfaces of the downloaded layout objects accessible
20 to the corresponding definition elements;
21 downloading from storage connector objects corresponding to
22 interaction elements in the instance of the object model;
23 making interfaces of the downloaded connector objects
24 accessible to the corresponding interaction elements; and
25 passing each element in the instance of the object model to the
26 corresponding downloaded object and executing said object to cause the
27 object to render the element, thereby effecting the user interface to the
28 application.

1 2. The method of claim 1 wherein:
2 the definition elements comprise
3 one or more elements defining appearance of the user
4 interface, and
5 one or more elements defining behavior of the user interface
6 toward the user.

1 3. The method of claim 2 wherein:
2 the elements defining appearance are expressed in a
3 descriptive language, and
4 the elements defining behavior are expressed in an interpretive
5 language.

1 4. The method of claim 2 wherein:
2 the elements defining appearance are expressed in a markup
3 language, and
4 the elements defining behavior are expressed in a scripting
5 language.

1 5. The method of claim 2 wherein:
2 the elements defining appearance are expressed in XML, and
3 the elements defining behavior as expressed in JavaScript.

1 6. The method of claim 1 wherein:
2 storing at least one description document defining a user
3 interface comprises
4 storing a plurality of description documents defining a plurality
5 of user interfaces;
6 storing a plurality of layout objects comprises
7 storing a plurality of layout objects each comprising a control for
8 rendering a different definition element of a plurality of user interfaces; and

9 storing a plurality of connector objects comprises
10 storing a plurality of connector objects each comprising a
11 control for rendering a different interaction element of the plurality of user
12 interfaces.

1 7. The method of claim 6 wherein:
2 the plurality of user interfaces comprise
3 user interfaces to a plurality of different applications; and
4 storing at least one description document defining interaction
5 comprises
6 storing at least one plurality of description documents defining
7 interactions of the plurality of user interfaces with the plurality of
8 applications.

1 8. The method of claim 7 wherein:
2 the user interfaces include a telephony user interface and a
3 graphical user interface.

1 9. The method of claim 6 wherein:
2 the plurality of user interfaces comprise
3 a plurality of different user interfaces to a same application; and
4 storing at least one description document defining a user
5 interface comprises
6 storing a plurality of description documents defining the plurality
7 of different user interfaces to the application.

1 10. The method of claim 9 wherein:
2 the interfaces include a telephony user interface and a
3 graphical user interface.

1 11. The method of claim 6 wherein:

2 the plurality of user interfaces comprise
3 user interfaces of a plurality of types of user access devices to
4 a same application; and
5 storing at least one description document defining a user
6 interface comprises
7 storing a plurality of description documents defining the plurality
8 of user interfaces to the application.

1 12. The method of claim 11 wherein:
2 the interfaces include a telephony user interface and a
3 graphical user interface.

1 13. The method of claim 6 wherein:
2 the plurality of user interfaces share a common description
3 document.

1 14. The method of claim 13 wherein:
2 the interfaces include a telephony user interface and a
3 graphical user interface.

1 15. The method of claim 1 wherein:
2 reflecting comprises
3 downloading the description documents,
4 parsing the description documents into their constituent
5 elements, and
6 generating a corresponding node in the instance of the object
7 model for each of the constituent elements.

1 16. The method of claim 1 wherein:
2 the downloaded layout objects form a layout engine for
3 rendering the user interface to the user.

1 17. The method of claim 16 wherein:
2 the downloaded connector objects form a connector engine for
3 connecting the user interface to the application.

1 18. The method of claim 1 wherein:
2 the layout objects are user-interface-dependent objects, and
3 the connector objects are user-interface-independent objects.

1 19. The method of claim 1 wherein:
2 the layout objects are access-device-specific and application-
3 neutral objects, and
4 the connector objects are application-specific and access-
5 device-neutral objects.

1 20. The method of claim 1 wherein:
2 storing at least one description document comprises
3 generating the at least one description document by using a
4 software developer's kit, software tools, and a definition of the user
5 interface object model.

1 21. The method of claim 20 wherein:
2 each step of storing a plurality of objects comprises
3 generating the plurality of objects by using the software
4 developer's kit, the software tools, and the definition of the user interface
5 object model.

1 22. The method of claim 1 wherein:
2 the one or more definition elements define at least one of a
3 menu, a prompt, and a command, and
4 the one or more interaction elements define features of the
5 application.

1 23. The method of claim 1 wherein:
2 storing at least one description document defining a user
3 interface comprises
4 storing a plurality of description documents defining a plurality
5 of different user interfaces and each comprising one or more definition
6 elements; and
7 storing a plurality of layout objects comprises
8 storing a plurality of layout objects each comprising a control for
9 rendering a different definition element of the plurality of user interfaces.

1 24. The method of claim 23 wherein:
2 the plurality of user interfaces includes a telephony user
3 interface and a graphical user interface.

1 25. The method of claim 1 wherein:
2 each step of making interfaces accessible comprises
3 registering interfaces of the downloaded objects in the instance
4 of the object model.

1 26. An apparatus for implementing a user interface to an
2 application, comprising:
3 a memory for storing (a) a description document conforming to
4 a user interface object model, defining a user interface and comprising
5 one or more definition elements, (b) a description document conforming to
6 the user interface object model, defining interaction of the user interface
7 with the application and comprising one or more interaction elements, (c)
8 a plurality of layout objects each comprising a control for rendering a
9 different definition element, and (d) a plurality of connector objects each
10 comprising a control for rendering a different interaction element; and
11 a processor for connecting to the memory and for (a) reflecting
12 the description documents into the object model to generate an instance

13. of the object model defining the user interface and comprising the
14 definition elements and the interaction elements of the description
15 documents, (b) downloading from the memory layout objects
16 corresponding to the definition elements in the instance of the object
17 model, (c) downloading from the memory connector objects corresponding
18 to the interaction elements in the instance of the object model, (d) making
19 interfaces of the downloaded layout objects accessible to the
20 corresponding definition elements, (e) making interfaces of the
21 downloaded connector objects accessible to the corresponding interaction
22 elements, and (f) invoking execution of said each downloaded object with
23 its corresponding element from the object model to cause the object to
24 render the element, thereby effecting the user interface to the application.

1 27. An apparatus that effects the method of any one of the
2 claims 1-25.

1 28. A computer-readable medium containing instructions
2 which, when executed in a computer, cause the computer to perform the
3 method of any one of the claims 1-25.